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Description

METHOD OF DETERMINING AN OPTIMAL CONTROL PROFILE FOR ADJUSTING TRAY-IN/OUT SPEEDS OF AN OPTICAL DISK DRIVE

BACKGROUND OF INVENTION

[0001] 1. Field of the Invention

[0002] The present invention provides a method for adjusting tray-in/out speeds of a tray, and more particularly, a method of determining an optimal control profile for adjusting tray-in/out speeds of a tray in an optical disk drive.

[0003] 2. Description of the Prior Art

[0004] Tray-in/out speeds of a tray in a prior art optical disk drive are constant. The prior art optical disk drive controls the tray-in/out speeds with a direct-current motor by means of an open-loop-control method. The open-loop-control method includes operations of constant volt-

age/current, constant control profile, etc.

[0005] The open-loop-control method is to provide tray-in/out forces for the tray according to operations of the optical disk drive.

[0006] However, considering the cost of production, the prior art optical disk drive includes merely a limit switch instead of close-loop sensors for detecting whether the tray arrives at its end-stop.

[0007] In mass production, owing to: (1) different tray-in/out forces due to variations in disk clampers, (2) inconsistency of devices with different friction forces, and (3) different ways of oil filling with different brake forces, an unique and constant control profile is not suitable for all optical disk drives.

[0008] Furthermore, improper tray-in/out speeds can cause the tray to be incapable of driving all the way to its end-stop, or to accelerate rapidly, causing an optical disk to be out of position (i.e. dropped out from the tray) with excessive force. Therefore, to prevent the above-mentioned problem, a method for control tray-in/out speeds of a tray is expected.

Summary of Invention

[0009] It is therefore a primary objective of the claimed invention

to provide a method for adjusting tray-in/out speeds of an optical disk drive tray.

[0010] According to the claimed invention, the method of determining an optimal control profile for adjusting tray-in/out speeds of a tray in an optical disk drive including the following steps:

[0011] (a) ejecting the tray using an initial control profile;

[0012] (b)measuring tray-out speed at a plurality of points in the initial control profile;

[0013] (c)determining a plurality of comparison values derived from comparisons between the plurality of tray-out speeds of step (b) and a plurality of predetermined tray-out speeds; and

[0014] (d)determining an optimal control profile according to the comparison values of step (c).

[0015] These and other objectives of the claimed invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0016] Fig.1 illustrates a schematic diagram of driving current for

a tray versus time in a control profile.

[0017] Fig.2 illustrates a schematic diagram of tray-out speeds versus the tray-out distance of the tray.

[0018] Fig.3 illustrates a flowchart of the present invention determination of the optimal control profile.

DETAILED DESCRIPTION

[0019] In first embodiment, a plurality of control profile sets for tray-in/out speeds of a tray in an optical disk drive are established, and an optimal control profile of the tray is thus selected by aid of pre-established sensors.

[0020] Please refer to Fig.1, which illustrates a control profile graph of drive current for the tray versus time. If the control profile is applied to drive the tray for movement (drive tray-out for example), ejection force is provided by a positive drive current before time point t3. After time point t3, the tray has almost reached its end-stop, so a brake force is provided by a negative current to stop the tray as it approaches the end-stop.

[0021] Please refer to Fig.2, which illustrates a graph of tray-out speeds versus the tray-out distance of the tray. The optical disk drive divides the tray-out distance into five segments with five points in addition to the origin, s1, s2, s3, s4, and s5, a sensor is set up in each point for determin-

ing tray-out speeds V10, V20, V30, V40, and V50. The tray accelerates from zero to V10 before point s1 with the initial ejection force, and then decelerates to V20 at point s2 and then to V30 at point s3; with a lowering and subsequent inversion of drive current, the tray decelerates significantly between time points t3 and t5 due to the brake force, and stops at time point t5.

[0022] The prior art optical disk drive with a constant control profile cannot provide optimal tray-in/out speeds of the tray, so the present invention provides a method for determining the optimal control profile.

[0023] Firstly, the optical disk drive sets a plurality of control profile sets as follows:

[0024] add1: (F1,t1;F2,t2;F3,t3;F4,t4;F5,t5)

[0025] add2: (F1+ΔF1,t1;F2,t2;F3,t3;F4,t4;F5,t5)

[0026] add3: (F1,t1+Δt1;F2,t2;F3,t3;F4,t4;F5,t5)

[0027] add4: (F1−ΔF1,t1;F2,t2;F3,t3;F4,t4;F5,t5)

[0028] The control profile set add1 is a default control profile of the optical disk drive, which means that the tray is driven with a force F1 at time point t1 in Fig.1, and similarly, forces F2 to F5 at time points t2 to t5.

[0029] The control profile set add2 provides a force F1+ΔF1 to

the tray at time point t1, so the acceleration of the tray under control profile set add2 is higher than under control profile set add1.

[0030] According to the control profile sets, the optimal control profile for tray-in/out speeds of the tray can be obtained. Please refer to Fig.3, which illustrates a flowchart of the present invention determination of the optimal control profile. The process includes:

[0031] Step 100: eject the tray with an initial control profile add1.

[0032] Step 110: measure tray-out speeds V11, V21, V31, V41, and V51 at five points (i.e. S1, S2~S5). With a timer and sensors set at the above points, the time duration for the tray to pass through the points can be measured and thus tray-out speeds determined.

[0033] Step 120: compare the tray-out speeds V11, V21, V31, V41, and V51 with predetermined tray-out speeds. If acceptable, the process undergoes step 140, or else the process undergoes step 130. The optical disk drive sets the predetermined tray-out speeds before the process. If the tray-out speeds differ from the predetermined tray-out speeds beyond a predetermined range owing to some inconsistency of the optical disk drive, the present invention will change the initial control profile according to the

comparison results.

[0034] Step 130: determine a control profile add for ejecting the tray, and repeat step 110 and step 120 until the optimal control profile is obtained. In this step, if the control profile cannot provide an optimal tray-out speed for the tray, the optical disk drive will select the most proper control profile from the control profile sets according to the comparison values between the practical tray-out speeds and the predetermined tray-out speeds. For example, if V11 is higher than the predetermined tray-out speed and V21~V51 are normal, the optical disk drive selects the control profile add4, and repeats steps 110 and 120 for determining whether the control profile add4 is the optimal control profile. The process repeats steps 110 to 130 unless the optimal control profile is obtained.

[0035] Step 140: write the current control profile to EEPROM. In this step, the most proper control profile is written or overwritten (if EEPROM exits a control profile) into EEPROM of the optical disk drive, which generally stores an operating control profile.

[0036] The above-mentioned steps are taken before the optical disk drive leaves a factory, so as to provide the proper (optimal) control profile according to a particular type of

optical disk drive. The present invention can also determine the optimal control profile according to tray-in speeds of the tray, or according to both tray-in and tray-out speeds of the tray.

[0037] The present invention can be utilized not only in production, but also for a user to determine the control profile with applied software, or to select a preferred control profile from a plurality of predetermined control profile sets (such as fast, slow, and medium modes) using the applied software for adjusting tray-in/out speeds.

[0038] In addition to tray driving systems, in another embodiment, the present invention can also adjust opening/closing speeds of a motor-driven cover (such as a CD-Player with the cover) with the above-mentioned process.

[0039] Therefore, the advantage of the present invention is the ability to adjust tray-in/out speeds of a tray in an individual optical disk drive, so as to provide optimal tray-in/out speeds thus solving the prior art problems, i.e. inability in driving the tray to its end-stop, or rapid acceleration causing an optical disk to be dropped out from the tray with excessive force.

[0040] Furthermore, another advantage is that a user can adjust the tray-in/out speeds according to individual preference.

That is, when the user feels that the tray is too fast in bringing an optical disk to a particular position, the user can force the optical disk drive to adjust tray-in/out speeds automatically with applied software, or select a control profile for determining optimal tray-in/out speeds.

[0041] Those skilled in the art will readily observe that numerous modifications and alterations of the device may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.